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Lesson plan
All about rocket science

Straw glider
A lesson about drag

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Materials needed:

Four drinking straws

Paper

Ruler

Pen

Tape

Scissors

How does the hoop glider work?

There are many variations on this design. Some having only 1 straw, 2 straws or 4 straws, but the concept remains the same.

The glider gets lift needed to glide from the two loops instead of wings. The loops do not have wing tips meaning they have less drag making the design streamlined.
On a rocket we use lift to guide the direction of flight, and drag is the air resistance we have to overcome with thrust from the rocket's engine.

Experiment questions
How does the straw length affect flight?
If you place the hoops at different places on the straw does it affect flight? You can cut straws shorter or tape two straws together to test this.
Does adding more loops work better or worse?
How far does it fly

Send us some pictures we would love to see.

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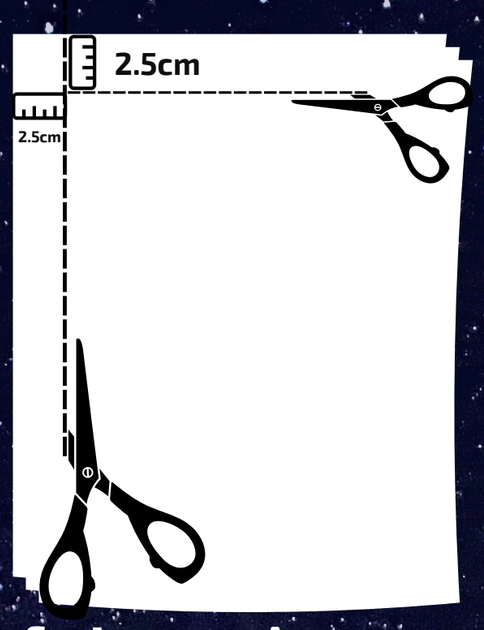
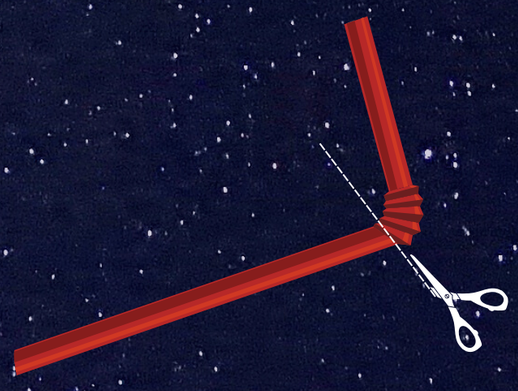
Steps

1. Cut a 2.5 centimetre strip from the long-side of a piece of stiff paper or index card. Then cut a 2.5 centimetre strip from the short side of paper. You want to end up with 2.5 cm by 13 cm.

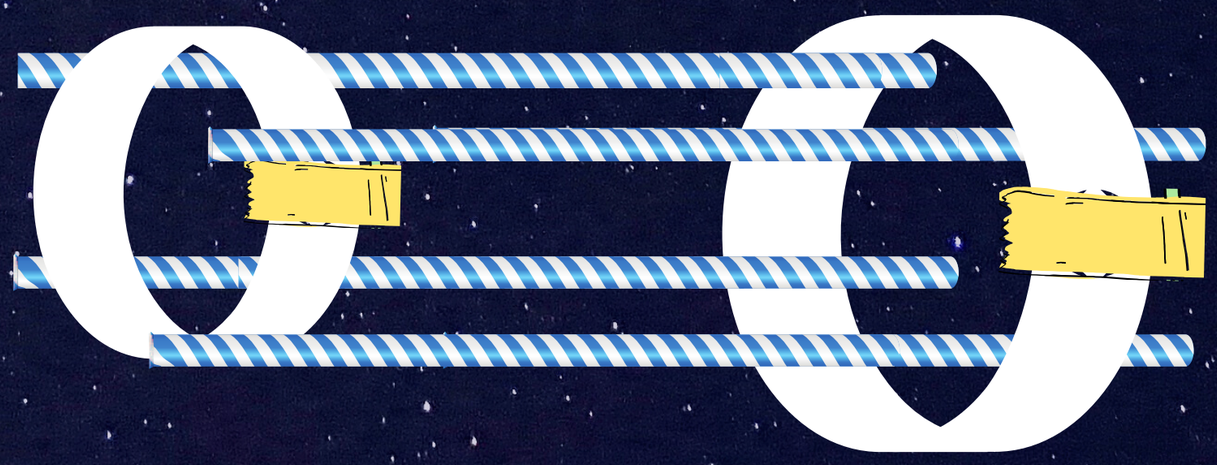


2. Tape the ends of the strips together to make a loop. Overlap the pieces of paper by 1 cm to make sure they keep their round shape when taped.

3. Cut the bendy straws to make them straight.



4. Attach the four straws to the inside of the larger loop and the outside of the smaller loop using tape.



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The science behind Skyrora's straw glider

There are four forces that affect how things fly:

- **Weight** is the force of gravity. It acts in a downward direction toward the centre of the Earth
- **Lift** is the force that acts at a right angle to the direction of motion through the air and it is created by differences in air pressure
- **Thrust** is the force that propels a flying machine in the direction of motion – engines produce this thrust
- **Drag** is the force that acts opposite to the direction of motion which is caused by friction and differences in air pressure

All four of these factors are explored in this experiment as they are major factors contributing to rocket launch. A spacecraft has weight, even in orbit, and uses thrust to reach space and to manoeuvre. However, lift and drag – both created by movement through air – are absent in the near vacuum of space.

In this experiment, the curvature of the two loops of the straw glider help generate the lift that it needs. Gravity pulls the glider toward the ground, and your arm that launches the glider into the air provides thrust. The motion of the glider through the air also generates drag, but with the drag unopposed the glider quickly slows down until it can no longer generate enough lift to oppose the weight. The aerodynamic curvature of the two loops reduces the amount of drag.

In a powered rocket, the drag is the air resistance that is overcome with the thrust from the rocket's engine, and lift is used to guide the direction of flight. The aerodynamic shape of a rocket also reduces the amount of drag. During rocket launch, the scale of the aerodynamic forces – which are drag and lift – depend on the shape, size, and velocity of the rocket and on the quality of the atmosphere.

The amount of air resistance or drag that opposes the motion of the Skyrora XL vehicle depends mainly on the shape of the nose cone and the diameter of the rocket. The first point that meets the air is the nose cone at the front end of the rocket. As this rocket will travel at a speed less than the speed of sound, the best shape of the nose cone is a rounded curve, which has been included in its design.

Rockets with a larger diameter have more drag because there is more air that is being pushed out of the way. Drag depends on the cross-sectional area of the object pushing through the air, therefore making the Skyrora XL vehicle as narrow possible is the best way to reduce drag.

The lift of a rocket is a side force used to stabilise and control the direction of flight. Skyrora XL will use a gimbal engine suspension to control the lift of the rocket.